comments as we may see fit to introduce. To those of our patrons who are not already versed in the mysteries of hand-railing, this announcement should be welcome, as it will place them in a position to obtain a knowledge of the art with the least expenditure of time and money possible; and to those who have acquired a knowledge of the art, this system will be instructive and interesting, inasmuch as it shows them how some of the long-winded problems are cut short by the simple application of two hinged boards.

The chief feature of this system is its extreme simplicity, and we have no hesitation in saying that any one of our readers who will take the trouble to study the text and plates as we publish them, will, at the close of the present volume, be able to build almost any kind of a hand-rail, from a knowledge acquired by such study.

We shall at all times take pleasure in answering any question regarding this system, and hope our readers will not be backward in making known their troubles.

The following is a description of the first plate, where the instruments to be used are shown:

PLATE 2.

Fig. 1 is the sector, on which the system is founded; is made of two boards joined together with hinges, so that the joint on the face will be close in any position; the edges bevelled so as to allow it to fold back to an angle of ninety degrees. Each leaf may be two feet long by one foot wide, with the ends clamped to prevent warping.

Fig. 2 is a section of Fig. 1, showing a brace of wire to keep it in position to any angle.

Fig. 3 is the tangent bevel, used on the face of the sector to obtain tangents.

Fig. 4 is the bevel used on the sector and tangent bevel, and produces the spring and plumb bevels on wreath pieces of rail.

Fig. 5 is the plan of a semicircular piece of wreath. The horizontal lines of the triangles show the stretch-out of the convex and concave edges of the wreath, which is obtained by dividing the radius of the circle into four parts, taking three of them in the dividers and extending to five as shown; then draw lines, cutting chord as shown. The lines of the two triangles are parallel to each other.

Fig. 6 shows the method of obtaining the curve and joints of wreaths after the tangents are drawn from the sector.

By close inspection it will be seen that two lengths are shown—the stars showing the centre line of the curve to each piece. This will be shown to better advantage in succeeding drawings.

## Practical Carpentry.

If we wish to bisect a given angle like Fig. 1, Plate 6, we proceed as follows: Let A B C be the given angle. From the angular point B, with any radius, describe an arc, cutting B A and B C in the points *d* and *e*; also, from the points *d* and *e* as centres, with any radius greater than half the distance between them, describe arcs cutting each other in *f*; through the point of intersection *f*, draw B *f* D; the angle A B C is bisected by the straight line B D; that is, it is divided into two equal angles, A B D and C B D.

Another method is shown on Fig. 2. Let A B C be the given angle, as before. In A B take any two points D and E. On B C set off B F equal to B D, and B G equal to B E; join E F and D G, intersecting each other in H; join also B H, and produce it to any point K; the angle A B C is bisected by the line B K.

To trisect or divide a right angle into three equal angles. Let A B C, Fig. 3, be the given right angle. From the angular point B, with any radius, describe an arc cutting B A and B C in the points *d* and *g*; from the points *d* and *g*, with the radius B *d* or B *g*, describe arcs cutting the arc *d g* in *e* and *f*; join B *e* and B *f*: these lines will trisect the angle A B C, or divide it into three equal angles.

To erect a perpendicular from any point in a straight line proceed as follows: From the point C, Fig. 4, with any radius less than C A or C B, describe arcs cutting the given line A B in *d* and *e*; from these points as centres, with a radius greater than C *d* or C *e*, describe arcs intersecting each other in *f*: join *c f*, and this line will be the perpendicular required.

To erect a perpendicular on the end of a line, take any point *c* in Fig. 5, and with the radius or distance *c* B, describe the portion of the circle *d* B *e*; join *d c*, and extend it to meet the opposite circumference in *e*; draw the line B *e*, which will be the perpendicular sought.

The above can also be found by another method, as follows: From any scale of equal parts, as that represented by the line D, Fig. 6, which contains five, set off from B, on the line A B, the distance B *e*, equal to three of these parts; then from B, with a radius equal to four of the same parts, describe the arc *a b*; also from *e* as a centre, with a radius equal to five parts, describe another arc intersecting the former in C; lastly, join B C; the line B C will be perpendicular to A B. This mode of drawing right angles on paper is more troublesome than the method previously given; but in laying out grounds, fences, or foundations of buildings it is often useful, since only with a ten-"foot" rod the ground fence or building may be set quite square. The method is called the six, eight,

and ten method, and is demonstrated thus: The square of the hypothenuse, or longest side of a right-angled triangle, being equal to the sum of the squares of the other two sides, the same property must always be inherent in any three numbers, of which the squares of the two lesser numbers added together are equal to the square of the greater. For example, take the numbers six, eight, and ten; the square of six is thirty-six, and the square of eight is sixty-four; and thirty-six and sixty-four added together make one hundred, which is ten times ten, or the square of the greater number. Although these numbers, or any multiple of them, such as three, four, five, or twelve, sixteen, twenty, etc., are the most simple and most easily retained in the memory, yet there are other numbers, very different in proportion, which can be made to serve the same purpose; and for the advanced student we submit the following: Let $n$ denote any number; then $n^2 + 1$, $n^2 - 1$, and $2n$, will represent the hypothenuse, base, and perpendicular of a right-angled triangle. Suppose $n = 6$, then $n^2 + 1 = 37$, $n^2 - 1 = 35$, and $2n = 12$; hence, thirty-seven, thirty-five, and twelve are the sides of a right-angled triangle.

To bisect a given straight line, let A B, Fig. 7, be the given straight line. From the extreme points A and B as centres, with any equal radii greater than half the length of A B, describe arcs cutting each other in C and D: a straight line drawn through the points of intersection C and D will bisect the line A B in *e*.

To divide a given straight line into any number of equal parts. Let A B, Fig. 8, be the given line to be divided into five equal parts. From the point A draw the straight line A C, forming any angle with A B. On the line A C, with any convenient opening of the compasses, set off five equal parts towards C; join the extreme points C B; through the remaining points one, two, three, and four, draw lines parallel to B C, cutting A B in the corresponding points, one, two, three, four: A B will be divided into five equal parts, as required.

To describe an equilateral triangle upon a given straight line. Let A B, Fig. 9, be the given straight line; from the points A and B, with a radius equal to A B, describe arcs intersecting each other in the point C. Join C A and C B, and A B C will be the equilateral triangle required. An eminent mathematician once made the following observation regarding this problem: "It is remarkable that it is not perhaps possible to resolve, without employing the arc of a circle, the very simple problem, and one of the first in the elements of geometry, viz., to describe an equilateral triangle." "We have often attempted it," continues the same author, "but without success, while trying how far we could proceed in geometry by means of straight lines only." He did well to put in the *perhaps*, for the thing happens to be possible after all; but it shows by what trifle the greatest of men will sometimes be baffled. The following is submitted as a method remarkably simple and easy: Let A B, Fig. 10, be the given straight line, it is required to describe an equilateral triangle upon it without making use of the compasses or arcs of a circle. Bisect A B in D, as shown previously, draw A E perpendicular and equal to A D; join D E, and extend D A to F, making A F = D E; join also E F; then from D erect the perpendicular D C = E F, and join A C and C B: A B C will then be an equilateral triangle.

It is easy to see that $AC^2$ must be $4AD^2$; but $AC^2 = AD^2 + CD^2$ (47th Prop. Euclid), and $CD^2 = EF^2 = FA^2 + AE^2 = AE^2 + DE^2$; but $DE^2 = AD^2 + AE^2 = 2AD$. . . $CD^2 = 3AD^2$, and $AC = AB^2 = 4AD^2$.

*(To be continued.)*

## Intercommunication.

THIS department is intended to furnish, for the benefit of all our readers, practical information regarding the art of manipulating wood by hand or machinery; and we trust that every reader of our paper will make the fullest use of it, both in asking and answering. All persons possessing additional or more correct information than that which is given relating to the queries published, are cordially invited to forward it to us for publication. All questions will be numbered, and in replying it will be absolutely necessary, in order to secure due insertion, that the NUMBER and TITLE of the question answered should be given; and in sending questions, the title of key-words of the question should be placed at the head of the paper. Correspondents should in all cases send their addresses, not necessarily for publication, but for future reference. We also request that all questions or answers be written on separate slips of paper, and addressed to the Editor. Notes of practical interest will be welcome at all times. When drawings are sent to illustrate answers to questions, or for full pages, they should be on separate slips, and should be drawn in ink on clean, white paper. Short questions, requiring short answers, may be asked and answered through the agency of postal cards.

When answers to questions are wanted by mail, the querist must send a stamp for return postage.

### Queries.

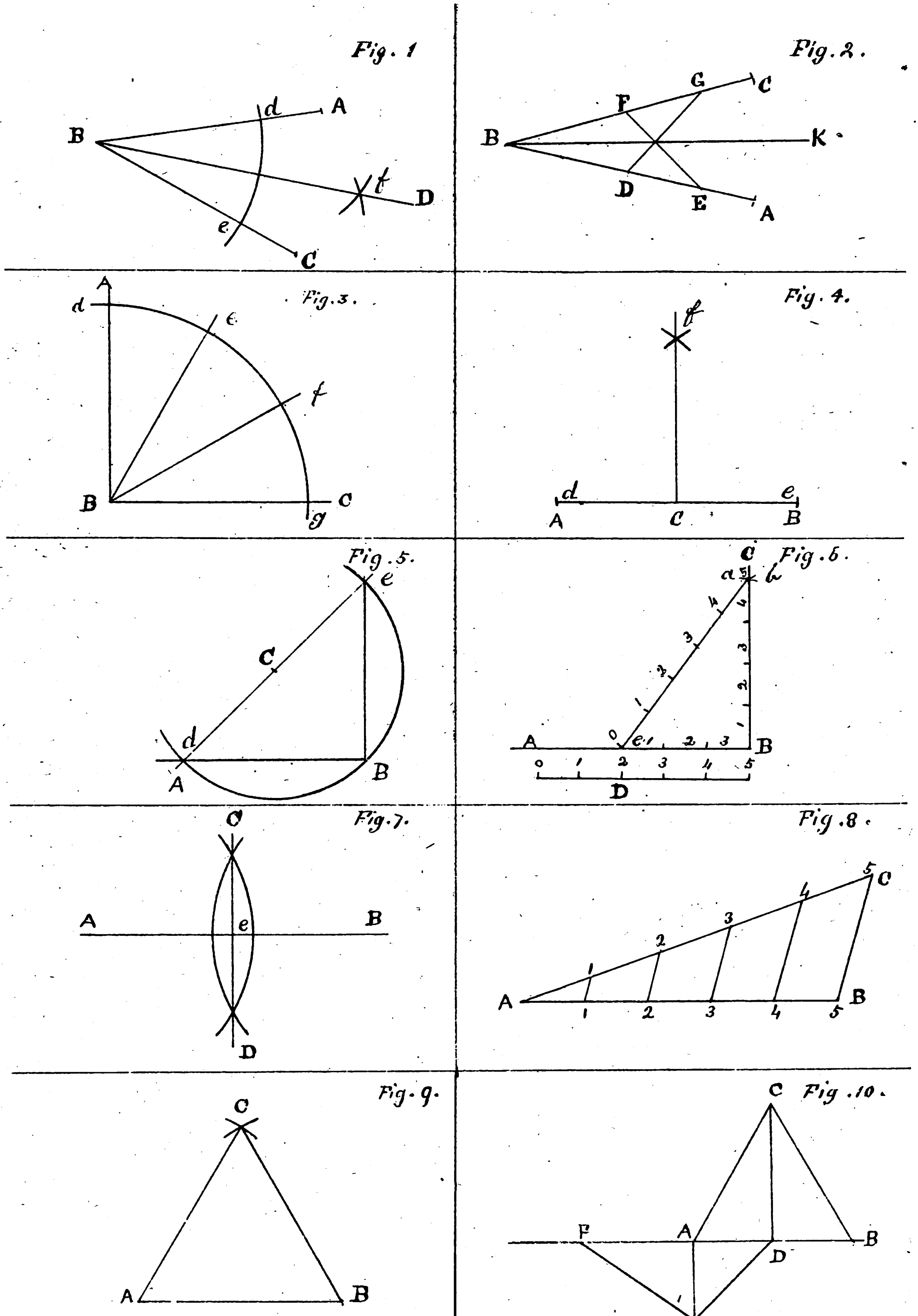
1. PLANE IRONS.—Why are Butcher's plane irons marked with numbers one, two, three, four, etc.?—A. P. G.

2. PICTURE-FRAMES.—Is it best, in making picture-frames, to glue them at the corners, which is "endwood," or just brad them together?—A. P. G.

3. FILLING.—How can I make a good filling for chestnut and black-walnut?—A. P. G.

4. COMBINATION PLANES.—What firm manufactures the best combination match planes and fillisters of iron in this country; and do these combination planes soon get out of order by frequent changing?—A. P. G.

PLATE. 6




PRACTICAL CARPENTRY.